MRL-TN-522

AR-005-164

(4)

DTIC FILE COPY

DEPARTMENT OF DEFENCE

DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION

MATERIALS RESEARCH LABORATORIES

MELBOURNE, VICTORIA

AD-A189 314

TECHNICAL NOTE

MRL-TN-522

A DEFECT INVESTIGATION OF THUNDERFLASH MK N5 (NAVY)

DTIC ELECTE FEB 17 1988 S D

Scott Murdoch

Approved for Public Release

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DSTO MRL MARIBYRNONG

SEPTEMBER 1987

88 2 16 003

DEPARTMENT OF DEFENCE
MATERIALS RESEARCH LABORATORIES

TECHNICAL NOTE

MRL-TN-522

A DEFECT INVESTIGATION OF THUNDERFLASH MK N5 (NAVY)

Scott Murdoch

ABSTRACT

This technical note describes the examination of Thunderflash devices which had been stored in sealed metal ammunition boxes. The ammunition boxes had exhibited severe swelling during storage and this was found to be due to a reaction between the photoflash composition in the device and moisture. The result of this reaction was the pressurization of the boxes with hydrogen gas.

POSTAL ADDRESS: Director, Materials Research Laboratories
P.O. Box 50, Ascot Vale, Victoria 3032, Australia

CONTENTS

A DEFECT INVESTIGATION OF THUNDERFLASH SMALL MK N5 (NAVY)

1. INTRODUCTION

MRL received a request from the Royal Australian Navy to investigate the swelling of metal ammunition boxes containing Thunderflashes, Small Mk N5. The Thunderflashes, manufactured to specification NOID 52204 at the Munitions Filling Factory, St Mary's between 1972-82, had been stored on both Australian naval vessels and in land based magazines. A number of the devices from some of the lots involved were examined at MRL. Evidence was found of a reaction between moisture and the magnesium in the pyrotechnic photoflash composition. A consequence of this reaction was the pressurization of the ammunition boxes with hydrogen gas.

2. BACKGROUND

The Thunderflash, Small Mk N5 (Fig.1) consists of a cylindrical cardboard tube, closed at one end by a cork plug. The cylinder is filled with the photoflash composition SR 801B which was developed in 1944 at the Royal Armament Research and Development Establishment, RARDE, Fort Halstead, UK. The composition contains 57% magnesium powder grade 4, 37% potassium perchlorate and 6% graphite. The devices are ignited by striking a match composition, located at the top of the cylinder. A length of safety fuse provides an interval which enables the device to be safely hand deployed. After a specified time, the fuse ignites the photoflash filling resulting in a loud explosion and a high intensity flash of light. The outer surface of the cardboard cylinder is weatherproofed with a coating of shellac and is fitted with an identification label. A protective rubber cap which covers the match composition is removed before use (Fig.2).

Ten Thunderflash devices with one striker are supplied wrapped in waxed paper and sealed in a polythene envelope. Ten of these packages are stored in an M2A1 ammunition box which incorporates a rubber seal in the lid

(Fig.3). The free space in the box is packed with waxed paper to protect the contents against rough handling.

The Thunderflash devices have a recommended service life of four years, with a potential service life of ten years subject to routine periodic inspection and proof [1].

3. INVESTIGATIONS

Swelling due to internal pressure was observed in a number of M2A1 boxes each containing one hundred Thunderflash devices. Reports from the Naval Quality Assurance Representative (NQAR), Newington indicated that some of these boxes had been opened within the last twelve months yet, at the time of this initial inspection, no swelling was observed. It has been determined that the internal pressure required to swell the M2A1 boxes to the degree observed could be as high as 100 kPa [2], therefore ammunition boxes that exhibited deformation due to internal pressure were considered unsafe for transport. A number of Thunderflash devices from these boxes were repackaged and forwarded to MRL for examination. Samples of the photoflash composition were taken from devices under manufacturing Lots, 5 MY 3/72, 4 MY 3/72, 33 MY 3/79, 3 MY 6/82 and analysed for free magnesium content. The results are listed in Table 1.

TABLE 1

Sample	Year of Manufacture	Free Magnesium (%)
Lot 5 MY 3/72	1972	34.1 37.9 35.1
Lot 4 MY 3/72	1972	38.0 37.1 38.2
Lot 33 MY 3/79	1979	41.5 47.7 47.0
Lot 3 MY 6/82	1982	55.0 55.2

The free magnesium content was determined by the Eudiometric method [3]. The results show that the percentage of free magnesium decreases significantly with the age of the stores. Cackett [4] states that magnesium is one of the most reactive metals used in pyrotechnic compositions and will undergo deterioriation in the presence of moisture. Magnesium reacts with water to produce magnesium hydroxide and hydrogen gas. The gas evolved can exert dangerously high pressures in hermetically sealed stores or containers.

The paper components in the Thunderflash contain moisture. It is therefore expected that the magnesium will react, liberating hydrogen gas. Should this reaction continue, a point will be reached where the device will fail to function due to insufficient free magnesium in the photoflash filling.

4. CONCLUSION

MRL have examined the pyrotechnic filling from a number of Thunderflash, Small Mk N5 devices. The examination indicates a depletion of the free magnesium content in the filling caused by a reaction between the magnesium and moisture. A consequence of this reaction is the liberation of hydrogen gas. The volume of gas evolved is sufficient to generate a high pressure in sealed ammunition boxes. It is recommended on the basis of this investigation that the Thunderflash devices stored in boxes that exhibit swelling be destroyed.

To overcome the problem of excessive gas generation, a number of alternatives may be considered for a replacement device:-

(i) the photoflash filling could be modified by developing a suitable coating for the magnesium, or

(ii) aluminium is less readily attacked by water because of the continuous film of oxide formed on its surface, therefore it may be possible to replace the current filling with an aluminium fuelled photoflash composition, or

(iii) the device could be redesigned using non-paper components in contact with the photoflash filling.

5. ACKNOWLEDGEMENTS

The assistance of Mr W. Bracken, NQAR, Newington, Mrs S. Spencer of Explosives Research Group, MRL and Mr M. Wilson of Explosives Materials Group, MRL is gratefully acknowledged.

6. REFERENCES

1. "Director of Naval Ordnance Inspection Orders" Vol 2 No. 4.9.6.1 (issued 24th February 1986).

2. Wilson, M. and Bird, R. (1986). "Defect Investigation of Cartridge Illuminating 1-1/2 inch", MRL-TN-501, Materials Research Laboratories, Maribyrnong, Australia.

3. Davidson, R.G. (1972). "Chemical Analysis of Flash Composition". DSL-TN-254, Defence Standards Labs (now Materials Research Laboratories.), Maribyrnong, Victoria.

4. Cackett, J.C. (1965). "Monograph on Pyrotechnic Composition". Special RARDE publication. RESTRICTED

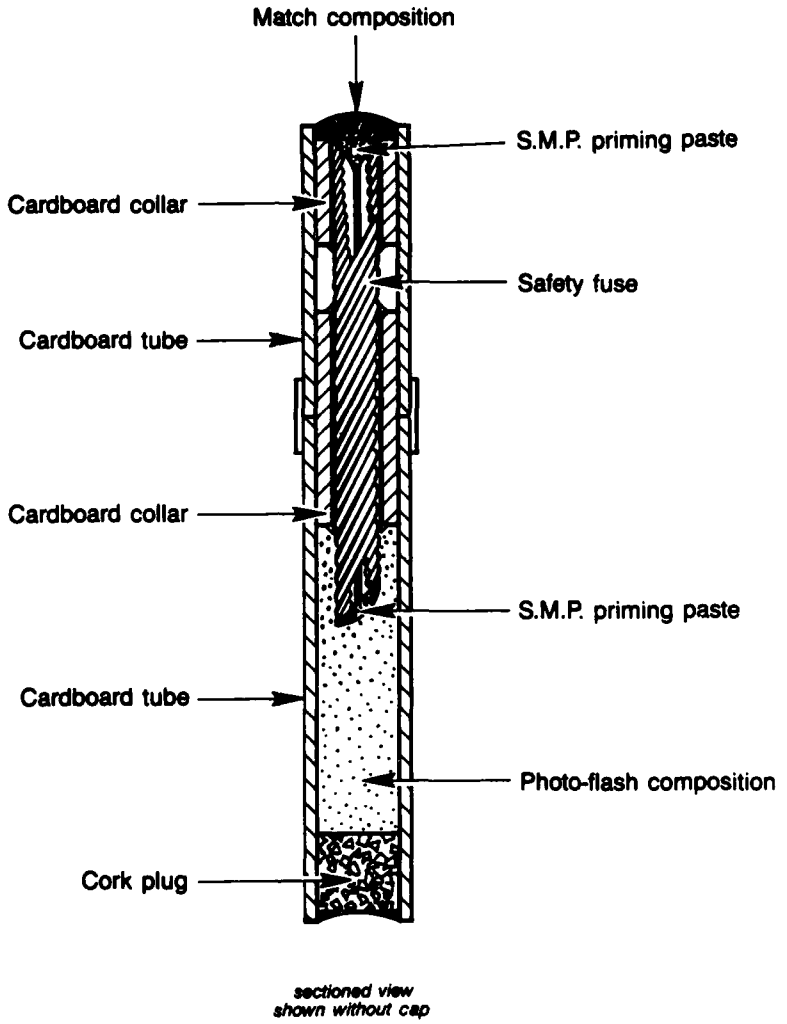

FIGURE 1 Thunderflash, Small Mk N5.

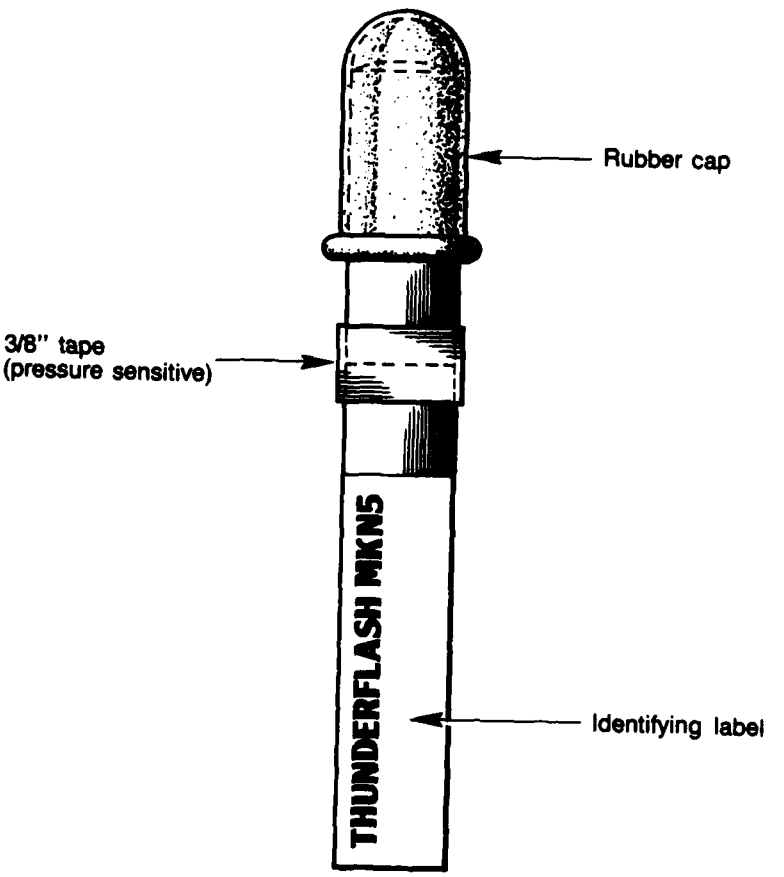

FIGURE 2 Thunderflash, Small MK N5.

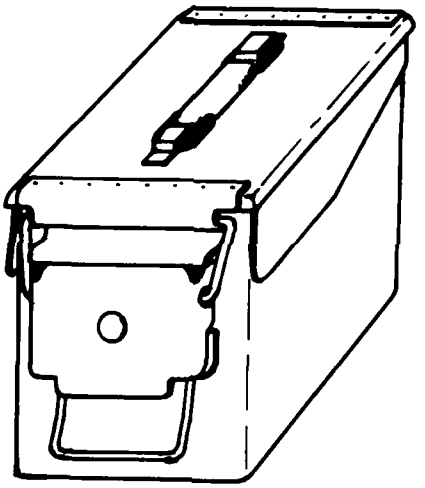

FIGURE 3 M2A1 Ammunition box

SECURITY CLASSIFICATION OF THIS PAGE **UNCLASSIFIED**

DOCUMENT CONTROL DATA SHEET

REPORT NO.	AR NO.	REPORT SECURITY CLASSIFICATION
MRL-TN-522	AR-005-164	Unclassified

TITLE

A defect investigation of thunderflash Mk N5 (Navy)

AUTHOR(S)

Scott Murdoch

CORPORATE AUTHOR

Materials Research Laboratories
PO Box 50,
Ascot Vale, Victoria 3032

REPORT DATE	TASK NO.	SPONSOR
September 1987	NAV 146/85	Navy

FILE NO.	REFERENCES	PAGES
G6/4/8-3313	4	10

CLASSIFICATION/LIMITATION REVIEW DATE	CLASSIFICATION/RELEASE AUTHORITY
September 1990	Superintendent, MRL Physical Chemistry Division

SECONDARY DISTRIBUTION

Approved for Public Release

ANNOUNCEMENT

Announcement of this report is unlimited.

KEYWORDS

Photoflash	Ammunition	Pyrotechnics	Swelling
Ammunition	Containers	Storage	Hydrogen
Thunderflash			

SUBJECT GROUPS 0079A

ABSTRACT

This technical note describes the examination of Thunderflash devices which had been stored in sealed metal ammunition boxes. The ammunition boxes had exhibited severe swelling during storage and this was found to be due to a reaction between the photoflash composition in the device and moisture. The result of this reaction was the pressurization of the boxes with hydrogen gas.